

Ing. Alessandro Cidronali

Dip. Elettronica e Telecomunicazioni, www.unifi.it/miclab

Laurea Specialistica in Ingegneria Elettronica

libri consigliati:

1. G. Ghione, Dispositivi per la Microelettronica, ed McGraw-Hill
2. W. Liu, Fundamentals of III-V Devices: HBTs, MESFETs, and HFETs/HEMTs, ed Wiley

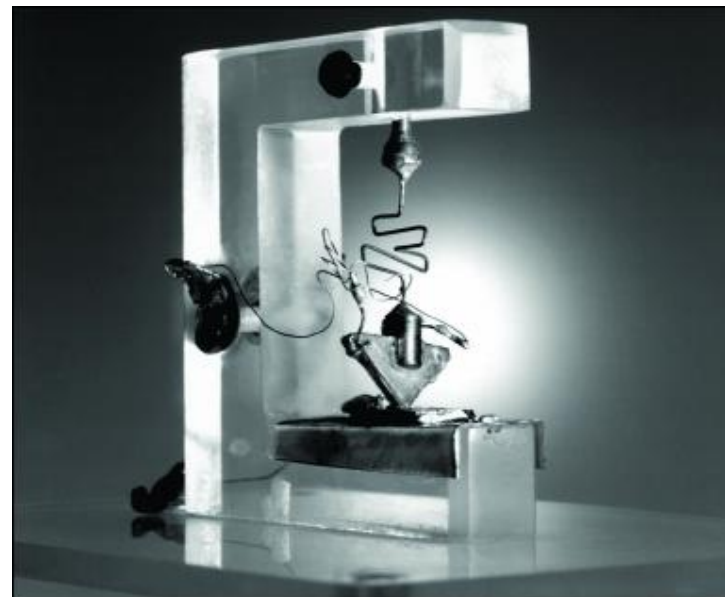
esami:

- 1 appello 30 giugno 2008 ore 15:00 presso DET
- 2 appello 18 luglio 2008 ore 15:00 presso DET

The Start of the Modern Electronics Era



Bardeen, Shockley, and Brattain at Bell Labs - Brattain and Bardeen invented the bipolar transistor in 1947.



The first germanium bipolar transistor.

Evolution of Electronic Devices

Vacuum
Tubes



(a)

Discrete
Transistors



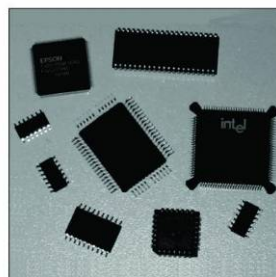
(b)

SSI and MSI
Integrated
Circuits



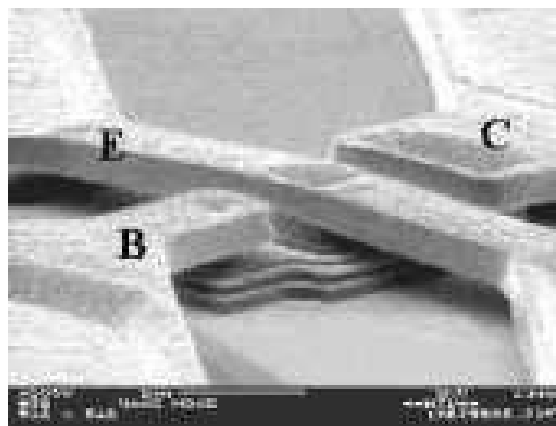
(c)

VLSI
Surface-Mount
Circuits

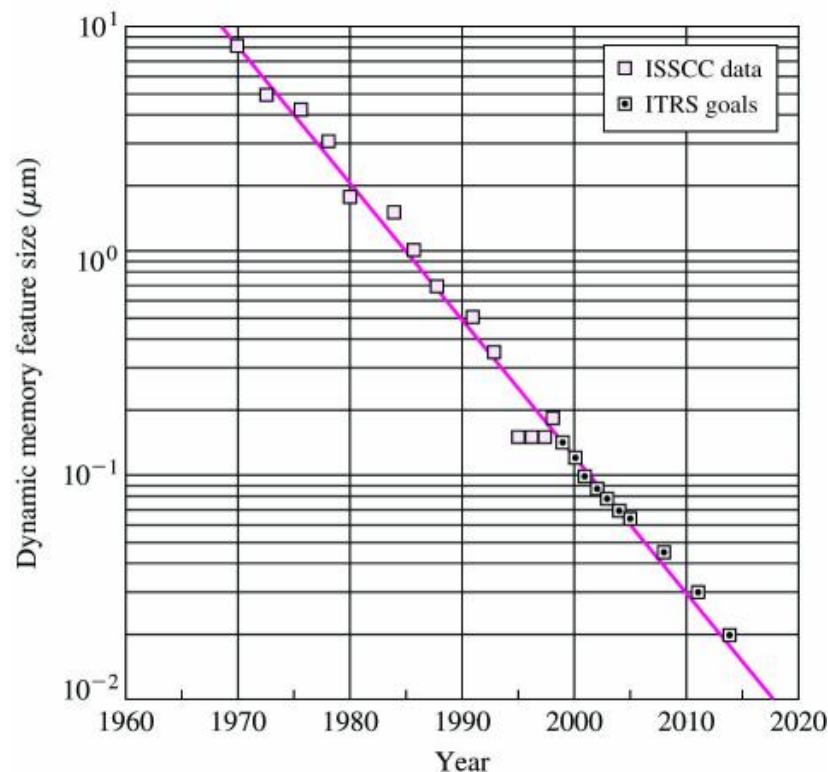


(d)

Integrated
Bipolar transistor

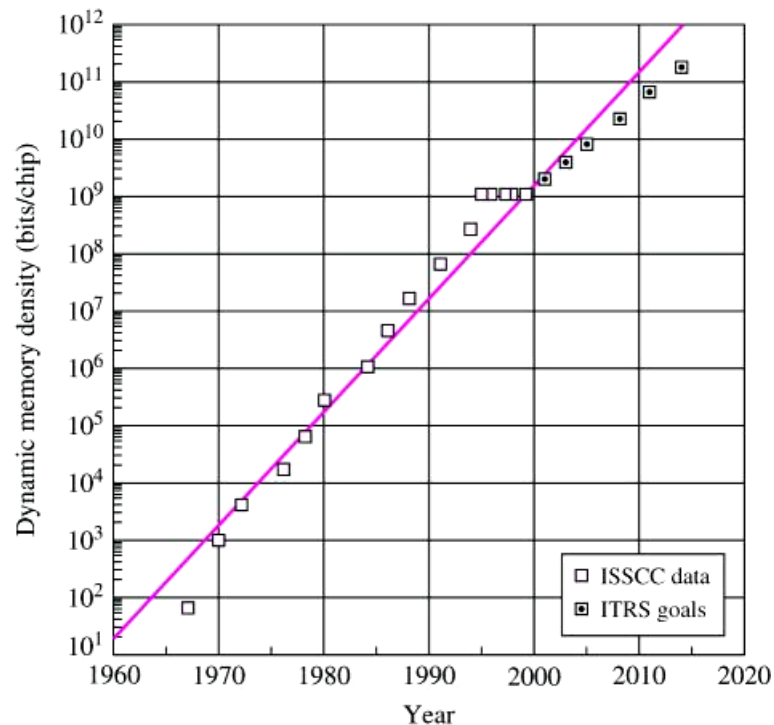


Device Feature Size

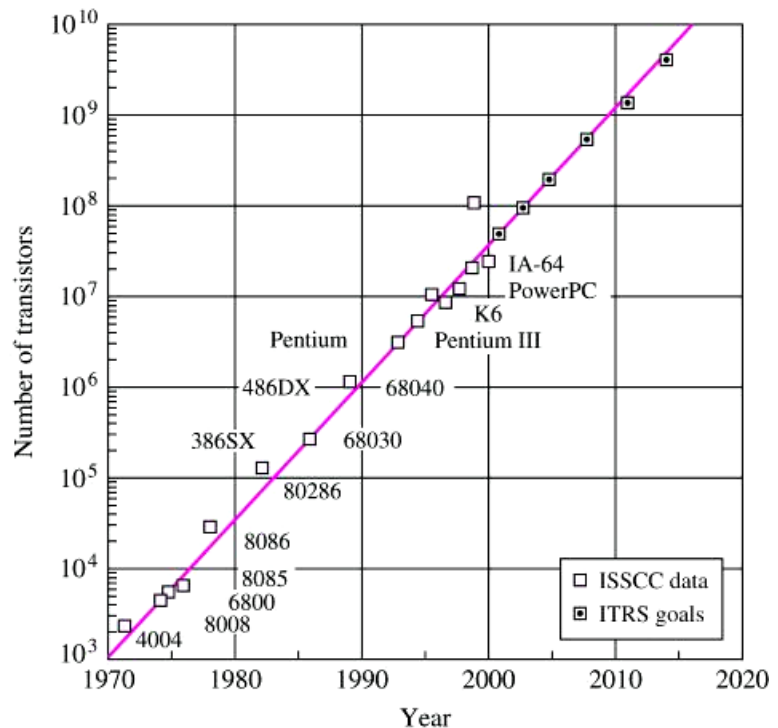


- Feature size reductions enabled by process innovations.
- Smaller features lead to more transistors per unit area and therefore higher density.

Rapid Increase in Density of Microelectronics



Memory chip density
versus time.

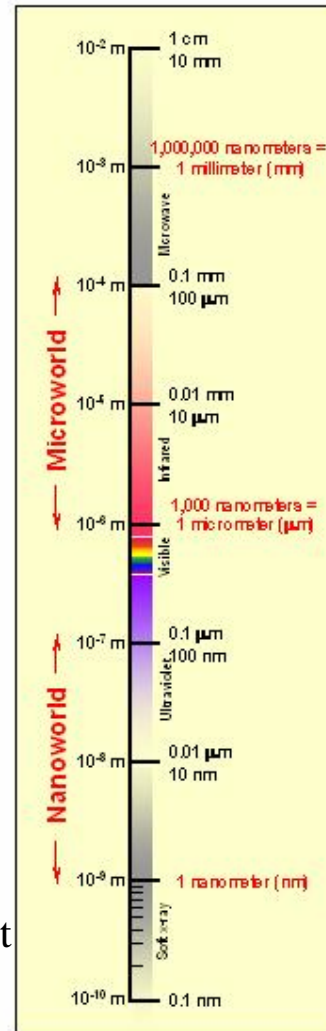


Microprocessor complexity
versus time.

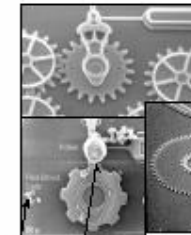
Nanotechnology the scale of things, nanometers and more

During the last decade, developments in the areas of surface microscopy, silicon fabrication, biochemistry, physical chemistry, and computational engineering have converged to provide remarkable capabilities for understanding, fabricating and manipulating structures at the atomic level.

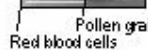
Research and technology in nanoscience is exploding, both because of the intellectual attraction of constructing matter and molecules one atom at a time, and because the new technical capabilities permit creation of materials and devices with significant societal impact. The rapid evolution of this new science and the opportunities for its application promise that nanotechnology will become one of the dominant technologies of the 21st century.



Head of a pin
1-2 mm

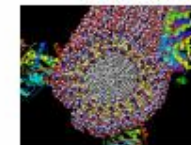
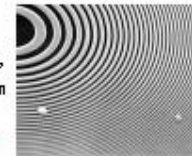


Micro Electro Mechanical (MEMS) devices
10 - 100 μm wide

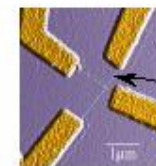


Pollen grain
Red blood cells

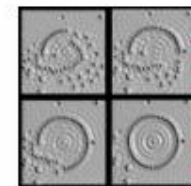
Zone plate x-ray "lens"
Outer ring spacing ~35 nm



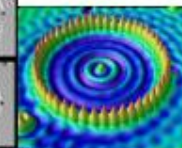
Self-assembled,
Nature-inspired structure
Many 10s of nm



Nanotube electrodes



Quantum corral of 48 iron atoms on copper surface
positioned one at a time with an STM tip
Conical diameter 14 nm



Carbon nanotube
~1.3 nm diameter

